

## Suicidal poisoning in Alexandria, Egypt-An updated statement

Suicidal poisoning in Alexandria, Egypt

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### Abstract

**Aim:** Suicide patterns and sociodemographic descriptions vary widely from country to country and over time. The study presented updated data about magnitude and pattern of suicidal poisoning deaths and attempts in Alexandria, Egypt.

**Material and Methods:** A retrospective descriptive study was performed, by investigating autopsy and criminal laboratory reports of confirmed suicide cases by poisoning, at the Medicolegal Authority Alexandria department, and patients' admission files at Alexandria Poison Centre (APC), Alexandria University, Egypt from January 2017 to December 2019.

**Results:** Suicidal deaths by self-poisoning accounted for 4.9% of autopsies. There was a significant increase in the annual rate of complete suicide by self-poisoning ( $p < 0.001$ ); 62.4% of complete suicide cases were between the ages of 10 and 20 years; 67.3% of cases were females; 87.1% were from rural areas, 30.7% of cases were in secondary school; 43.6% of cases were unemployed; 69.3% were single; 96% of suicidal deaths were due to pesticides, 51.5% of them were due to Zinc phosphide. The highest percentage of cases was in spring (36.6%); 7205 cases (34.3%) were attempted suicides admitted to APC, 42% of them were between the ages of 10-20 years, 74% were females and 72.7% were from urban areas. Medications were mostly used for attempting suicide (57.3%), followed by pesticides in 26.9% of cases. The highest percentage of cases was admitted in July (12.8%) then May (10.4%).

**Discussion:** Complete suicide and suicide attempts by self-poisoning in Alexandria, Egypt, were mostly among teenage females. The most common poisons used for attempting suicide were medications in urban regions. However, most of the deaths occurred due to pesticides in rural areas.

### Keywords

Complete suicide; Suicide attempts; Pattern; Sociodemographic; Alexandria; Egypt

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## Introduction

One of the most commonly used ways of suicide is the intentional intake of large quantities of prescribed or non-prescribed substances. This includes overdose of therapeutic or recreational substances, carbon monoxide poisoning from car exhaust, ingestion of flammable liquids, solvents, pesticides or cyanide [1].

In fact, intentional self-poisoning for the purpose of suicide is a growing public health problem with numerous emergency department admissions. According to the WHO, yearly, almost one million peoples die from suicide and 20 times more peoples attempt suicide (World Health Organization. (2014). Preventing suicide: A global imperative. Retrieved from [https://www.who.int/mental\\_health/suicide-prevention/world\\_report\\_2014/en/](https://www.who.int/mental_health/suicide-prevention/world_report_2014/en/)).

Unlike other usually used ways of suicide, hanging and poisoning by carbon monoxide from car exhaust gases, the toxic effects of drug overdose may not occur for numerous hours or days after the attempt. For this purpose, most people who take overdoses reach hospital alive, and the medical interventions they receive in hospital are likely to prevent a proportion of deaths [2].

In fact, prevalence, characteristics and methods of committing or attempting suicide differ extensively between different societies and over time. Accordingly, up-to-date investigation of suicides and suicide attempts is a crucial element of national and local suicide prevention efforts.

Egypt has always been listed by the World Health Organization (WHO) to have the lowest suicide rate, at less than five suicides per 100,000 people. However, as a cultural belief, suicide is considered a stigma and a sinful act. That is why suicide cases in Egypt are often registered as accidental deaths by families of the deceased.

Although many previous Egyptian studies concerning suicide have been carried out, the growing number of suicides and attempted suicide by self-poisoning in Alexandria in recent years, urges continuous updating of research. Thus, the present study aimed to provide an updated data on the magnitude and pattern of suicidal poisoning deaths and suicidal poisoning attempts in Alexandria, Egypt.

## Material and Methods

### *I. Cases of complete suicide:*

A retrospective descriptive study was carried out by investigating autopsy and criminal laboratory reports of cases of confirmed suicide by poisoning, at the Medicolegal Authority Alexandria Department, Egypt, between January 2017 and December 2019. The Medicolegal Authority Alexandria department as well as Alexandria Poison Centre (APC), in Alexandria, Egypt serves many governorates besides Alexandria Governorate, such as Marsa Matrouh Governorate, El-Behera and Kafr Elshikh.

At the Medicolegal Authority Alexandria department, all cases of suspected suicide by poisoning were subjected to external and internal autopsy to rule out any signs of violence, after which samples (gastric contents, blood and urine) were taken and transferred to the criminal laboratory for analysis. Organophosphorus pesticides were analyzed using GC-NPD and GC-MS, while carbamate pesticides were analyzed using HPLC-UV and GC-MS. Pyrethroid and chlorinated pesticides were detected using GC-ECD and GC-MS. Moreover, Zinc phosphide

and Aluminum phosphide were detected by silver nitrate test and head space GC.

For every confirmed case of suicide by poisoning, all available data were collected. It included socio-demographic data of individuals like age, sex, residence, occupation, level of education and marital status, as well as information about the poison used (type and time of incidence).

### *II. Cases of attempted suicide:*

A retrospective descriptive study was done by examining patients' admission files at Alexandria Poison Centre (APC), Alexandria University, Egypt, from January 2017 to December 2019.

All available data were collected on the sociodemographic characteristics of patients (age, sex, residence) and data related to patient's admission, such as the substance used for attempting suicide and time of admission.

Suicide attempts resulting in death were omitted from the section of attempted suicide and included in the section of complete suicide to avoid duplication of cases.

### *Ethical considerations*

Approvals from the Ethics Committee of Alexandria Faculty of Medicine (IRB No: 00012098, FWA No: 00018699) and the Medicolegal Authority Alexandria department, Egypt were taken prior to the study.

### *Statistical analysis*

Quantitative data were described by mean and median as measures of central tendency and standard deviation, minimum and maximum as measures of dispersion, while categorical variables were summarized by frequency and percent. Chi-square test was used to study significant association between two categorical variables. Monte Carlo significance was used if more than 20% of total expected cell counts was <5 at .05 level of significance.

For categorical variables > 2 categories (types of poison and years of suicide), we performed either analysis of variance (ANOVA) or Kruskal-Wallis tests to compare mean and median quantitative variables. The choice of either test was based on variables' distribution by Kolmogorov-Smirnov test and sample size per group.

All statistical tests were two-sided and were performed using IBM SPSS statistics program version 21.

## Results

### *I. Cases of complete suicide:*

During the study period, 2077 autopsies were performed in the Medico-legal Authority Alexandria Department, Egypt. Out of which, 101 autopsies (4.9%) were related to suicidal deaths by self-poisoning, 57% were autopsied in 2019, 33% in 2018 and the least percentage (10%) in 2017.

Ten autopsies were related to suicide by self-poisoning out of 588 autopsies performed in 2017.

Thirty-three of 691 autopsies in 2018 were due to suicide by self-poisoning, while in 2019, 58 of 798 autopsies were due to suicide by self-poisoning. Significant increase in the annual rate of complete suicide by self-poisoning was observed in the present study, where  $p < 0.001$  (Figure 1).

### *Sociodemographic data:*

The age group 10-20 years accounted for 62.4% of complete

suicide cases, while the least percentage (2%) was in the age group of 60-70 years, 67.3% of the cases were females (Table 1).

Figure 2 shows that the highest percentage of cases in the age groups of 10-20 years, 20-30 years, and 40-50 years were females. While in the age group of 30-40 years, the highest percentage were males, 87.1% of them were from rural areas; 30.7% of cases were in secondary school, an equal percentage of 27.7% was given to illiterate, as well as intermediate education. While only one case had higher education, 43.6% of cases were unemployed, 30.7% were students and about one-quarter of cases, (25.7%) were workers; 69.3% were single, 22.8% of cases were married, 5.9% were divorced and only 2% were widows (Table 1).

Significant increase was noted in the number of females compared to males who committed suicide by self-poisoning throughout the study period, where  $p=0.005$  (Table1).

**Data related to the accident of suicide:**

Pesticides were used in 96% of suicides. Out of them, 51.5% used Zinc phosphide, and 24.8% of them used Aluminum phosphide as the substance of suicide.

The highest percentage of cases was in spring (36.6%), followed by summer (30.7%), then winter (28.7%) and 4% in autumn.

**Table 1.** Comparison of different sociodemographic characteristics of suicidal cases along different years (n=101)

	Total	Year of suicide			Sig
	No (%)	2017 (n=10)	2018 (n=33)	2019 (n=58)	
<b>Age</b>					
10-20 Ys	63(62.4)	5(50)	23(69.7)	35(60.3)	MCp.332
20-30 Ys	19(18.8)	4(40)	5(15.2)	10(17.2)	
30-40 Ys	14(13.9)	0	5(15.2)	9(15.5)	
40-50 Ys	3(3)	1(10)	0	2(3.4)	
50-60 Ys	0	0	0	0	
60-70 Ys	2(2)	0	0	2(3.4)	
<b>Sex</b>					
Female	68(67.3)	10(100)	26(78.8)	32(55.2)	p.005*
Male	33(32.7)	0	7(21.2)	26(44.8)	
<b>Residence</b>					
Rural	88(87.1)	10(100)	30(90.9)	48(82.8)	MCp.266
Urban	13(12.9)	0	3(9.1)	10(17.2)	
<b>Occupation</b>					
Unemployed	44(43.6)	6(60)	10(30.3)	28(48.3)	MCp.200
Worker	26(25.7)	2(20)	8(24.2)	16(27.6)	
Student	31(30.7)	2(20)	15(45.5)	14(24.1)	
Higher education	1(1)	0	0	1(1.7)	
<b>Education</b>					
Illiterate	28(27.7)	3(30)	7(21.2)	18(31)	MCp.629
Primary/Preparatory	13(12.9)	2(20)	3(9.1)	8(13.8)	
Intermediate	28(27.7)	3(30)	8(24.2)	17(29.3)	
Secondary	31(30.7)	2(20)	15(45.5)	14(24.1)	
Higher education	1(1)	0	0	1(1.7)	
Widow	2(2)	0	1(3)	1(1.7)	
<b>Marital status</b>					
Single	70(69.3)	9(90)	24(72.7)	37(63.8)	MCp.523
Married	23(22.8)	0	6(18.2)	17(29.3)	
Divorced	6(5.9)	1(10)	2(6.1)	3(5.2)	
Widow	2(2)	0	1(3)	1(1.7)	
Widow	2(2)	0	1(3)	1(1.7)	

\*results≤.05 are significant, MCp: Monte Carlo significance

There was a non-significant difference in the type of poison and season of poisoning according to the year of poisoning, where MCp= 0.875 and 0.298, respectively.

Among those who committed suicide using pesticides, 62.9% were in the age group 10-20 years, with a significant difference from other age groups (MC p=0.035), 68% of them were females, 88.7% were from rural areas. The highest percentage of them (29.9%) were secondary school students with a significant difference between different education levels (MC p= 0.035); 43.3% of those using pesticides for committing suicide were unemployed, and 69.1% of them were single with a significant difference from other groups (MCp=0.042); 36.1% of suicide by pesticides were in spring months. (Table 2)

**Table 2.** Comparison of annual rate, sociodemographic characteristics and season of suicidal cases according to type of poison. (n=101)

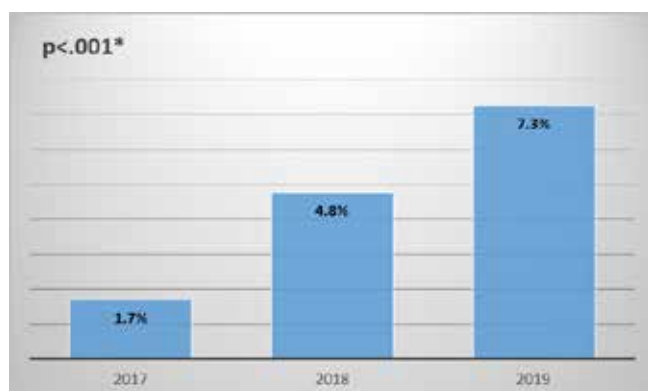
	Total	Type				Sig
		Pesticides (n=97)	Cyanide (n=1)	Anti-depressant (n=1)	un-known (n=2)	
<b>Annual rate</b>						
2017	10(9.9)	10(10.3)	0	0	0	MCp.876
2018	33(32.7)	33(34)	0	0	0	
2019	58(57.4)	54(55.7)	1(100)	1(100)	2(100)	
<b>Age</b>						
10-20 Ys	63(62.4)	61(62.9)	1(100)	0	1(50)	MCp.035*
20-30 Ys	19(18.8)	18(18.6)	0	0	1(50)	
30-40 Ys	14(13.9)	14(14.4)	0	0	0	
40-50	3(3)	3(3.1)	0	0	0	
50-60	0	0	0	0	0	
60-70 Ys	2(2)	1(50)	0	1(50)	0	
<b>Sex</b>						
Female	68(67.3)	66(68)	0	1(100)	1(50)	MCp.596
Male	33(32.7)	31(32)	1(100)	0	1(50)	
<b>Residence</b>						
Rural	88(87.1)	86(88.7)	1(100)	0	1(50)	MCp.078
Urban	13(12.9)	11(11.3)	0	1(100)	1(50)	
<b>Occupation</b>						
Unemployed	44(43.6)	42(43.3)	0	1(100)	1(50)	MCp.879
Worker	26(25.7)	26(26.8)	0	0	0	
Student	31(30.7)	29(29.9)	1(100)	0	1(50)	
<b>Education</b>						
Illiterate	28(27.7)	27(27.8)	0	1(100)	0	MCp.035*
Primary/Preparatory	13(12.9)	13(13.4)	0	0	0	
Intermediate	28(27.7)	28(28.9)	0	0	0	
Secondary	31(30.7)	29(29.9)	1(100)	0	1(50)	
Higher education	1(1)	0	0	0	1(50)	
Widow	2(2)	1(1)	0	1(100)	0	
<b>Marital status</b>						
Single	70(69.3)	67(69.1)	1(100)	0	2(100)	MCp.042*
Married	23(22.8)	23(23.7)	0	0	0	
Divorced	6(5.9)	6(6.2)	0	0	0	
Widow	2(2)	1(1)	0	1(100)	0	
Widow	2(2)	1(1)	0	1(100)	0	
<b>Season</b>						
Autumn	97(96%)	4(4.1)	0	0	0	MCp.312
Winter	1(1)	27(27.8)	1(100)	1(100)	0	
Spring	1(1)	35(36.1)	0	0	2(100)	
Summer	2(2)	31(32)	0	0	0	
Summer	2(2)	31(32)	0	0	0	

\*results≤.05 are significant, MCp: Monte Carlo significance

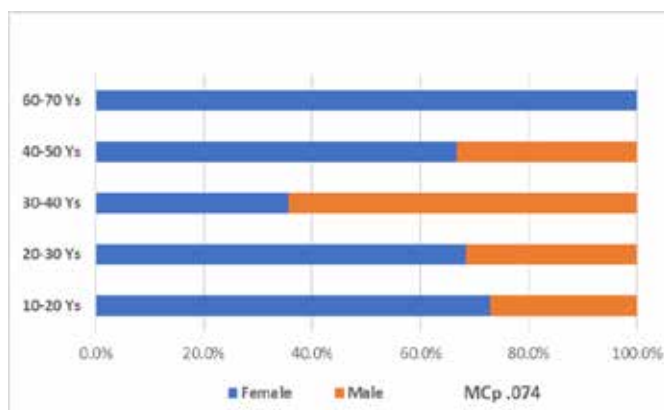
**II. Cases of attempted suicide:**

During the three years of study, 20983 cases of acute poisoning were admitted to Alexandria Poison Centre (APC); 7552 (36%) of these cases were admitted in 2019, with the least percentage (29%) in 2017.

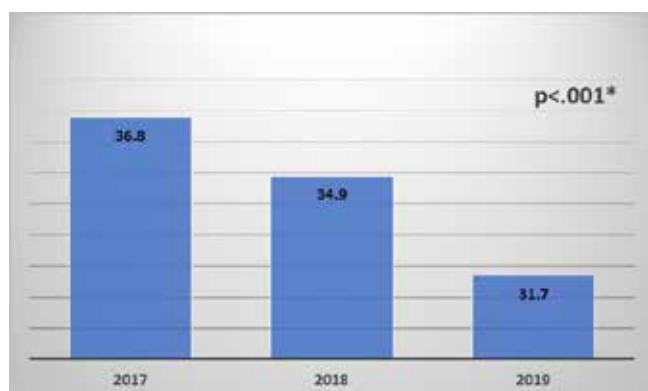
Out of all acute poisoning cases admitted to APC, 7205 cases (34.3%) were related to suicide attempt. The highest suicidal rate (36.8%) was in 2017, while the least (31.7%) in 2019. A significant decrease in the annual suicide attempt rate was noted in this study ( $p < 0.001$ ) (Figure 3).



**Figure 1.** Annual rate of suicide by self-poisoning during the three-studied years in relation to the total autopsies performed every year during the study period.



**Figure 2.** Relation between age and sex of suicidal cases during the study period.



**Figure 3.** Annual incidence rate of attempted suicide during the study period.

**Table 3.** Relation between age, sex, residence and date of admission with type of poison taken for attempting suicide

	Household products (n=290)	Pesticides (n=1939)	Medications (n=4129)	Drugs of abuse (n=67)	Unknown combination (n=780)	Sig‡
<b>Age</b>						
Mean(sd)	28.82 (11.63)	25.13 (10.52)	24.56 (9.29)	29.97 (10.26)	24.04 (9.71)	$p < .001^{**}$
10-20 Ys	90(31.0)	851(43.9)	1719(41.7)	6(9)	361(46.3)	
20-30 Ys	84(29.0)	658(33.9)	1589(38.5)	41(61.2)	266(34.1)	
30-40 Ys	70(24.1)	246(12.7)	553(13.4)	11(16.4)	110(14.1)	
40-50 Ys	31(10.7)	105(5.4)	197(4.8)	3(4.5)	26(3.3)	$MCp < .001^*$
50-60 Ys	12(4.1%)	70(3.6)	41(1)	6(9)	12(1.5)	
60-70 Ys	3(1)	9(0.5)	21(0.5)	0	5(0.6)	
70-80 Ys	0	0	9(0.2)	0	0	
<b>Sex</b>						
Male	149(51.4)	685(35.3)	779(18.9)	40(59.7)	191(24.5)	$p < .001^*$
Female	141(48.6)	1254(64.7)	3350(81.1)	27(40.3)	589(75.5)	
<b>Residence</b>						
Rural	58(20)	795(41)	892(21.6)	18(26.9)	207(26.5)	$p < .001^*$
Urban	232(80)	1144(59)	3237(78.4)	49(73.1)	573(73.5)	
<b>Date of admission</b>						
January	18(6.2)	79(4.1)	216(5.2)	3(4.5)	71(9.1)	
February	6(2.1)	125(6.4)	250(6.1)	0	121(15.5)	
March	18(6.2)	163(8.4)	205(5)	6(9)	113(14.5)	
April	33(11.4)	153(7.9)	360(8.7)	15(22.4)	117(15)	
May	29(10)	241(12.4)	436(10.6)	19(28.4)	23(2.9)	
June	12(4.1)	141(7.3)	303(7.3)	0	96(12.3)	
July	50(17.2)	248(12.8)	557(13.5)	9(13.4)	58(7.4)	$p < .001^*$
August	33(11.4)	223(11.5)	362(8.8)	0	52(6.7)	
September	34(11.7)	181(9.3)	337(8.2)	0	48(6.2)	
October	15(5.2)	129(6.7)	294(7.1)	3(4.5)	30(3.8)	
November	15(5.2)	141(7.3)	348(8.4)	6(9)	36(4.6)	
December	27(9.3)	115(5.9)	461(11.2)	6(9)	15(1.9)	

‡ results  $\leq .05$  are significant, \*Chi-Square test or Monte Carlo significance, \*\* ANOVA test significance, Sd: standard deviation, min: minimum, max: maximum

**Socio-demographic data:**

The mean age of patients was  $24.88 \pm 9.84$  years (min-max = 10-75 years). The highest percentages (42%) of suicide attempts were in the 10-20 years age group, 36.6% of them were in the 20-30 years age group; 13.7% of cases were in the 30-40 years age group, the least percentage (0.5%) was in the seventh decade of life (60-70 years); 74% of suicide attempts were females; 72.7% were from urban areas, while the remaining percentage (27.3%) from rural areas.

**Type of poison and date of admission:**

Drug use was the most common method of attempting suicide in the total study period (57.3%), followed by pesticides in 26.9% of cases. In 4.02% of cases, household products were used to attempt suicide.

The highest percentage of cases was admitted in July (12.8%), followed by May (10.4%), and the least percentage (5.4%) was in January; 41.7% of suicide attempts by medications, 43.9% of those taking pesticides, 46.3% of those taking unknown combinations and 31% of those using household products were from the 10-20 years age group; 61.2% of cases that used drugs of abuse for attempting suicide were from the 20-30 years age group. Significant difference was noticed between different

age groups and the type of poison used for attempting suicide, where  $MCp < 0.001$  (Table 3).

Significant difference was observed between males and females regarding type of poison used to attempt suicide. Females preferred to use unknown combinations (75.5%) and pesticides (64.7%), while males used drugs of abuse (59.7%) and household products (51.4%) (Table 3); 80% of cases using household products for attempting suicide, 59% of those using pesticides, 78.4% of cases using medications, 73.1% of those taking drugs of abuse and 73.5% of cases taking unknown combinations were from urban areas. Significant difference was noted between urban and rural residence according to type of poison taken with  $p < .001$ .

Significant relation was noticed between date of admission and type of poison taken for attempting suicide ( $p < .001$ ). The highest percentage of cases taking household products (17.2%), pesticides (12.8%) and medications (13.5%) was admitted in July. The highest percentage of those taking drugs of abuse (28.4%) and the highest percentage of cases taking unknown combinations (15.5%) were admitted in May and February, respectively.

## Discussion

Pattern and socio-demographic description of the problem of suicide, whether complete or attempts, differ widely in different societies and over time. Egypt, as a developing country, suffers from underreporting and lack of registration of suicide and suicide attempts. This may be due to the religious background that considers suicide as a sinful act. Moreover, the cultural beliefs in Egypt may cause stigmatization of suicide and attempted suicide. [3]

Alexandria is the second-largest city in Egypt located on the Mediterranean coast, with a population of 5,200,000. Alexandria Poison Centre (APC) and Medicolegal Authority Alexandria department, in Alexandria, Egypt serves many governorates beside Alexandria Governorate like Marsa Matrouh, El-Behera and Kafr Elshikh Governorates.

The aim of the present study was to provide updated data on the magnitude and pattern of suicidal poisoning deaths and suicidal poisoning attempts in Alexandria, Egypt.

During the three-year study period of this work, 7205 cases of attempted suicide and 101 autopsies were related to suicidal deaths by self-poisoning. These numbers represented about one third of all acute poisoning cases admitted to Alexandria Poison Centre and 4.9% of all autopsies performed in the Medico-legal Authority Alexandria department, Egypt. The present research showed significant decrease in the annual rate of attempted suicide with significant increase in the annual rate of death from self-poisoning. This may reflect the use of highly hazardous substances to commit suicide in recent years.

In an earlier study done in Alexandria Governorate, Egypt, from 2008 to 2012 [4], there were 25 cases of suicide by self-poisoning over the studied five years, that is in comparison with the present study, denotes, unfortunately, continuous increase in the number of deaths due to self-poisoning in the governorate. Regarding Cairo city, a study performed by Taha et al (2011) [3] showed that complete suicide by poisoning was diagnosed in only 36 cases over the five years from 1998 to 2002, most

of whom were females ( $n = 26$ , 72.20%). Moreover, Gad El Hak et al (2009) [5] carried out their study in Port Said city from 1998 to 2004. They concluded that 20 cases were dead due to suicidal rodenticide intake. On the other hand, in their study, Kordrostami et al (2017) [1] found that in a five-year study period, 1667 suicide cases were investigated in Legal Medicine Organization, Tehran, Iran, of which, 674 cases (40.43%) were due to self-poisoning.

In the present work, less than two-thirds of complete suicide cases were in the 10-20 years age group, while the least percentage (2%) was in the 60-70 years age group. Moreover, the present study found that the highest percentage of cases in the age groups 10-20 years, 20-30 years and 40-50 years were females. While in the 30-40 years age group, (the highest percentage were males. This result coincided with Prajapati et al (2013) [6] and Singh et al (2017) [7]. This may be attributed to the fact that teenagers, during this period of life, may suffer from many problems such as failure or low scores the exams, reproofing from parents or teachers, failure in love or family problems. On the other hand, people in their extremes of ages might suffer less stress than younger people. Moreover, according to WHO, suicide is considered the second leading cause of death in the ages 15-19 years.

On the other hand, this result demonstrated a lower age group than that obtained by Gad El Hak et al (2009) [5], Moneim et al (2011) [8] and Sherif et al (2014) [4], who found that the highest percentage of cases was in the 3rd decade of life, followed by those in the 4th decade. Moreover, Taha et al (2011) [3] concluded that the highest number of cases in both sexes was in the middle age group from 20 to 34 years. In a study from Kuwait (2015) [9], they found that the 4th decade accounted for most cases of suicide by poisoning.

Furthermore, in the present work, more than two thirds of complete suicide cases were females with significant increase in their numbers compared to males that committed suicide by self-poisoning throughout the study period. This result was in agreement with Schaffer et al (2017) [10] in patients with bipolar disorder. At the same time, Moneim et al (2011) [8] concluded that poisoning was the first most common cause of suicide in 70% of females and 29% of males included in their study.

On the other hand, this result contradicted many previous studies [1, 4, 8, 9, 11]. This difference in results may be due to the fact that many of these researches studied all methods of suicide, not only self-poisoning, that included other violent ones like hanging and firearms, which are mostly used by males. [8] In the present study, the majority of suicidal deaths due to self-poisoning occurred in rural areas. This may be due to many factors, here in Egypt as a developing country, such as easy accessibility of the means for suicide especially pesticides, difficulties in retrieving health care and in getting the necessary care. This result contradicted that of Prajapati et al (2013) [6], who found more suicide cases in urban regions.

Regarding the educational level, less than one third (30.7%) of cases were in secondary school, followed by illiterates as well as intermediate education, while only one case had higher education. This result coincided with Prajapati et al (2013). [6] Furthermore, in their study in Italy, Pompili et al (2013) [12] tried

to study the association between educational accomplishment and complete suicide. They concluded that suicide victims had significantly higher educational level compared to the people of the same sex and age deceased from natural causes. However, in a Japanese study, Kimura et al (2016) [13] found that high educational levels were linked to a decreased risk of suicide for both Japanese men and women. Phillips and Hempstead (2017) [14] concluded that male study participants with a high school degree had twice the rate to die from suicide than those with a college degree in 2000-2014.

On the other hand, 43.6% of cases were unemployed, 30.7% were students and about one quarter of cases, (25.7%) were workers. This result was in agreement with Singh et al (2017) [7], Kordrostami et al (2017) [1]. Kposowa et al (2019) [15] concluded that unemployment was significantly linked to suicide, and the influence of unemployment on suicide was much higher among females than males. In a study carried out in Hong Kong, Yip and Caine (2011) [16] found that in despite a strong correlation between unemployment and suicide rates in 2006, suicide rates among employed and unemployed groups turned into the opposite direction. This meant, suicide rate among the unemployed fell during economic collapse and increased during retrieval.

As for marital status, the highest percentage of cases (69.3%) was single, 22.8%- married, 5.9% -divorced and only 2% -widows. This coincided with many previous studies [1, 4, 9]. However, it was contrary to Singh et al (2017) [7] who found higher suicidal rates by poisoning among married persons more than the unmarried ones.

Concerning the substance used in suicide, in the present study, most of death cases in 96% of suicide were due to pesticides. Out of them, more than half (51.5%) used Zinc phosphide and less than one quarter (24.8%) used Aluminum phosphide as substance of suicide. This finding was in agreement with many previous studies. [1, 6, 8, 17]

In fact, using pesticides for self-poisoning especially in developing countries, is not a new phenomenon. It is a common incident in all developing countries not distinctive to a certain country. However, although being an old and universal problem, no comprehensive solution was taken. This may be due to the agricultural pattern in developing countries, where large numbers of people living in rural areas cultivate small land areas. Therefore, pesticides are available where most people live. This pattern is completely diverse from that in industrialized countries, where a small number of farmers cultivate large zones of land. Hence, access to pesticides is largely restricted to a few individuals involved in farming. Also, the pesticide trade is a multi-billion -dollar business that raises the tension between commercial benefits and population health. Industry cannot recognize the influence of the easy obtainability of lethal pesticides on patterns of suicide. Moreover, the self-inflicted nature of suicide, and the fact that there are fewer suicide deaths than deaths from other global health problems, may cause strategy makers giving it lesser importance than the number of premature deaths due to other causes. [18]

Regarding the season of the year during which attempted and completed suicide cases happened in this work, the highest percentage of cases was in spring (36.6%), followed by summer

(30.7%), then winter (28.7%), and the least percentage was in autumn (4%). Moreover, the present study demonstrates non-significant difference in the type of poison and season of poisoning according to the year of poisoning. As for suicidal attempts in the current study, the highest percentage of cases was admitted in July (12.8%) followed by May (10.4%) and the least percentage of cases (5.4%) was in January. Many previous studies concluded that suicides peak during spring and summer. A common and reasonable theory to explain this relationship is that increased exposure to sunshine changes biological mechanisms through dysregulation of serotonin and or melatonin production or metabolism. [1, 19-22]. However, it was contrary to Raut et al (2017) [17], who found the highest percentage of cases during winter.

The present research demonstrated that about two thirds of those committed suicide using pesticides (62.9%) were in the 10-20 years age group, with significant difference from other age groups, 68% of them were females and 88.7% were from rural areas. The highest percentage of them (29.9%) were secondary school students with significant difference between different education levels. Out of those using pesticides for committing suicide, 43.3% were unemployed and 69.1% were single, with significant difference from other groups. Moreover, 36.1% of suicides from pesticides were in spring months.

Regarding suicidal attempts, in the current study, the mean age of patients was  $24.88 \pm 9.84$  (min-max =10-75 years). The highest percentage (42%) of attempted suicides was in the 10-20 years age group, while the least percentage (0.5%) was in the 7th decade of life (60-70 years). Significant difference was noticed between different age groups and the type of poison used for attempting suicide; 41.7% of cases who attempted suicide by medications, 43.9% of those taking pesticides, 46.3% of those taking unknown combinations and 31% of those using household products were from the 10-20 years age group 10-20 years. While 61.2% of cases that used drugs of abuse for attempting suicide were from the 20-30 years age group, this range of age was significantly less than those obtained by Gunnell et al (2004) [23] and Assadi and Afshari (2016) [2].

Regarding sex, about three fourths of suicide attempts (74%) were females. These findings coincided with Imtiaz et al (2015) [24], Assadi and Afshari (2016) [2] and Spiller et al (2019) [25]. Concerning residence in the present work, less than three-fourths (72.7%) were from urban areas. This result coincided with Gondim et al (2017) [26].

The present study demonstrated that use of medications was the most common method of attempting suicide over the total study period (57.3%), followed by pesticides in 26.9% of cases. The least percentage of cases (4.02%) used household products as a method for attempting suicide. This was in agreement with Gunnell et al (2004) [23]. However, it was in contrary to that obtained by Imtiaz et al (2015) [24] and Gondim et al (2017) [26], who concluded that insecticides, and kerosene oil were the most commonly chemicals used for attempting suicide.

#### **Conclusion**

Based on the data of the present research, complete suicide and suicide attempts by self-poisoning, in Alexandria, Egypt, were more common among teenage females. The most common poison used for attempting suicide was medications in urban

regions. However, most deaths occurred due to pesticides in rural areas.

### Recommendations

Reporting and registration of suicide and suicide attempts should be mandatory in all hospitals in Egypt in to help assess the magnitude of the problem and developing a prevention program. Suicide prevention programs should be targeted at teenagers. Implementation of psychological autopsy in complete suicide cases may help in collection of information about the high risks associated with suicide, but it needs consent from decedents' families. Furthermore, controlling access to hazardous pesticides, like limiting their sale and securing their storage. In addition, better treatment of poisonings could help in minimizing numbers of suicide, especially in rural areas in Egypt. Further research is recommended to study the groups particularly at risk for attempted and completed suicide here in Egypt.

### Limitations

As this is a retrospective study, some information about factors related to chemical poisoning was missing in the current study, like the exact doses and the causes of suicide. Also, poor registration and health information systems affected collection of data.

### Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

### Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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### Conflict of interest

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